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MIDLAND STANDARD ENGINEERING & TESTING, INC.
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(847) 844-1895 f (847) 844-3875

October 30, 2018

Mr. Ken Jay, P.E.
City of St. Charles
Two East Main Street
St. Charles, Illinois 60174

Re: Soil Exploration and Analysis
Electrical Substation No. 3
St. Charles, Illinois
MSET File No. 18522

Dear Mr. Jay:

Midland Standard Engineering & Testing, Inc. has completed the field exploration and analysis for the above referenced project.

INTRODUCTION

Purpose and Scope

The purpose of this exploration and analysis was to determine the various components of the soil, the engineering characteristics of the foundation materials, and to provide criteria for use by the design engineers and architects in preparing the site and foundation design for the residential structures.

The scope of this exploration included a geological reconnaissance of the site, a review of available soil information, subsurface exploration, soil testing, and an engineering analysis and evaluation of the materials encountered.

General

The exploration and analysis of the foundation and subsurface conditions reported herein are considered in sufficient detail and scope to a form a reasonable basis for design. This report has been prepared for the exclusive use and specific application to the proposed project.

The recommendations submitted are based on the available soil information, standard residential construction, and available site location information. Any revision in the plans for the proposed structures from those enumerated in this report should be brought to the attention of the Soils Engineer to determine if changes in the recommendations are required. Any deviations from the noted subsurface conditions that are encountered during construction should also be brought to the attention of the Soil Engineer.

The Soils Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been promulgated after being prepared in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology. No other warranties are implied or expressed.

PROJECT LOCATION AND DESCRIPTION

Project Description

The project site is at the Electrical Substation No. 3, located on the north side of N. Riverside Avenue in St. Charles, Illinois. The site is one of many substation locations that distributes electricity throughout the city. Plans include expanding the substation for additional capacity.

FIELD EXPLORATION

General

Our exploration program consisted of making three (3) structure borings to a depth of fifteen (15) feet below the ground surface or to auger refusal. Borings were marked in the field by an MSET Field Engineer and were labeled B-1 through B-3. **Boring B-3 was omitted due to utility conflicts at the boring location.** Ground surface elevations were measured relative to the electric manhole, using an assumed elevation of 100.00.

Drilling Equipment

The soil borings were drilled using a track mounted Geoprobe® 7822DT drill rig equipped with a rotary head. Hollow stem augers were used to advance the boreholes.

Sampling and Standard Penetration Test Procedures

Representative samples were obtained by the use of split-spoon sampling procedures in accordance with A.S.T.M. Procedure D-1586.

During the split-spoon sampling procedures, a standard penetration test was performed in accordance with current A.S.T.M. D-1586 Procedures. At sampling intervals, advancement of the boring was stopped and all loose material removed from the borehole. The sampler was then lowered into the hole and seated in undisturbed soil by pushing or tapping, taking suitable precautions that the rods were reasonably tight. The sampling spoon was then advanced by driving with an automatic drop hammer. During the sampling procedure, the standard penetration value (N) of the soil was determined. The standard penetration value (N) is defined as the number of blows of a one hundred-forty pound (140 lb) hammer required to advance the spoon sampler one foot (12") into the soil.

The results of the standard penetration tests indicate the relative density and comparative consistency of the soils and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components. The results of standard penetration tests can be found on the boring logs, which are attached.

Strength Tests

A calibrated hand penetrometer was used to aid in determining the strength and consistency of cohesive soil samples (Qp) in the field. Split-spoon samples were subjected to unconfined compressive strength testing (Qu) by the RIMAC Method. Consideration must be given to the manner in which the values of the unconfined compressive strength were obtained. Split-spoon sampling techniques provide a representative, but somewhat disturbed soil sample.

Water Level Measurements

Water level observations were made during and after the boring operations and are noted on the boring logs presented herewith. In relatively pervious soils, such a sandy soils, the indicated elevations are considered reliable groundwater levels. In relatively impervious soils, the accurate determination of the groundwater elevation may not be possible, even after several days of observation. Seasonal variations, temperature and recent rainfall conditions may influence the levels of the groundwater table and volumes of water will depend on the permeability of the soils.

LABORATORY TESTING

Scope

A supplemental laboratory-testing program was conducted to ascertain additional pertinent engineering characteristics of the foundation materials necessary in analyzing the behavior of the proposed construction. The soils laboratory work was performed in accordance with applicable ASTM standards.

The laboratory-testing program included supplementary visual classification, unconfined compressive strength on cohesive samples and moisture contents on all samples. The results of laboratory testing are reported on the boring logs that are attached.

SUBSURFACE CONDITIONS

Fill Materials

Fill materials were encountered at boring B-1 to a depth of 5 feet below the existing ground surface elevation. The fill materials encountered are comprised of brown Crushed Stone over dark brown Sandy Lean CLAY (CL) and black SAND with Cinders (SP). The fill materials were slightly dense in consistency with standard penetration values (N) of 7 to 9 blows per foot and moisture contents of 18 to 24 percent.

Fill materials encountered at boring B-2, extended to a depth of 10.8 feet. Fill materials were comprised of brown Crushed Stone, possible backfill of nearby utility structures. The granular fill was very loose to medium dense with standard penetration values (N) of 2 to 11 blows per foot and moisture contents of 9 to 13 percent.

Soil Profile

Below the upper fill soils, natural profile soils encountered at boring B-1 included a thin layer of black Fat CLAY (CH) over dark grey Sandy Lean CLAY (CL) to a depth of 7 feet. The clay soils were stiff in consistency with unconfined compressive strengths (Qu) of 1.82 tons per square foot and moisture contents of 19 percent.

Below the upper clay soils, brown Clayey SAND (SC) was encountered to a depth of 8.2 feet. The granular soils were very dense with standard penetration values (N) of 60 blows per foot and moisture contents of 18 percent.

Bedrock comprised of Dolomitic LIMESTONE was noted at the boring locations at a depth of 8.2 and 10.8 feet at the boring locations. Auger refusal was noted at these depths and drilling operations stopped. Details of the soils encountered at each boring location are presented on the attached Boring Logs.

Groundwater Conditions

Groundwater measurements were made during and immediately after the drilling operations. Groundwater was encountered at boring B-2 in granular backfill at a depth of 6.0 feet during drilling. Groundwater was not encountered at the remaining boring location during or immediately after drilling was complete. Details of the groundwater measurements at each boring location are presented on the attached boring logs.

FOUNDATION RECOMMENDATIONS

Foundation Discussion

The anticipated structures are anticipated to be support on spread concrete footing founded on the weathered dolomitic limestone bedrock.

Exterior footing should be located at a minimum depth of 3-1/2 feet below final exterior grade to eliminate the effects of frost action and alleviate the effects of seasonal moisture variation on foundation system behavior. A net allowable bearing pressure of **10 tons per square foot** may be used to dimension the planned footings on the weathered bedrock at the elevations below:

Boring No.	Ground Surface Elevation	Depth to Bedrock	Elevation of Bedrock
B-1	99.5	8.2’	91.3
B-2	100.4	10.8’	89.6

Foundation Undercuts

Undercutting to remove marginal fills and natural profile soils are anticipated to expose weathered bedrock, suitable to support the planned structures. Footings should be constructed by “stepping” down to the referenced depth.

Surface and Groundwater Control

Excavations are anticipated to extend through granular fills into bedrock at a depth of 8 to 11 feet below the existing ground surface elevation. Perched water located in the upper granular fills was noted at boring B-2 at a depth of 6 feet and may enter the excavation during construction. The contractor should be prepared to maintain dry working conditions with a system of sumps and pumps when necessary. Additionally, sloping of the ground at the surface should be utilized to prevent surface runoff from entering the excavation.

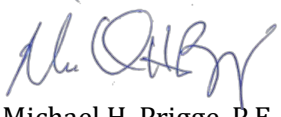
Excavation Safety

Shallow depth excavations through the granular fills will not stay vertical for any period of time and will tend to cave in rather quickly. Please note that OSHA requirements dictate the use of sloping back or shoring and bracing the excavation during construction. All work should be done in accordance with OSHA and local requirements.

Closure

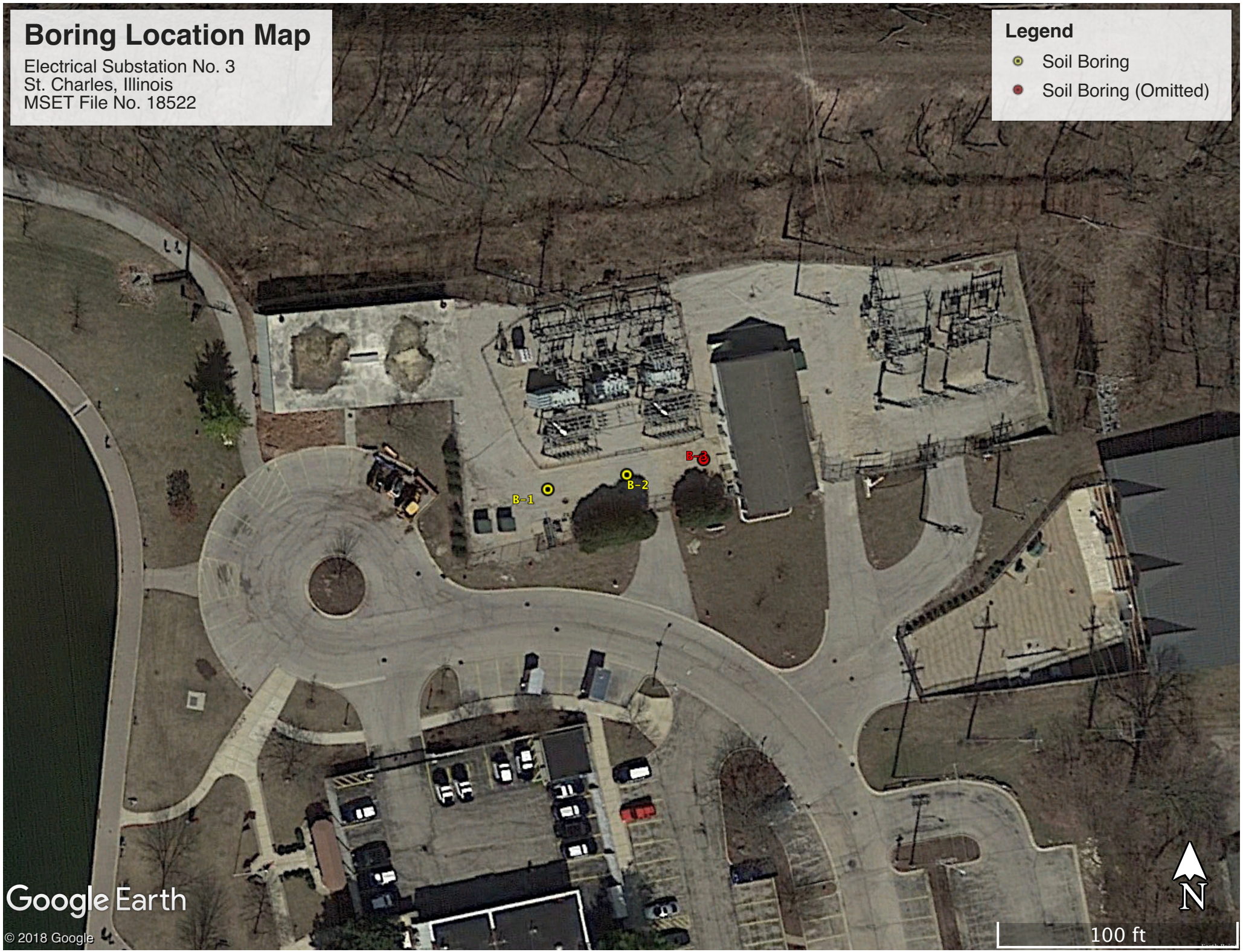
This report is based on the information available at this time. Additional information including site grades and building details should be provided for our review to assess impact to our recommendations. If you have any questions regarding this report, please feel free to call.

Sincerely,
MIDLAND STANDARD ENGINEERING & TESTING, INC.



Michael H. Prigge, P.E.
Project Engineer

Attachments: Boring Location Map
Boring Logs (B-1 and B-2)
General Notes


Boring Location Map
Electrical Substation No. 3
St. Charles, Illinois
MSET File No. 18522
Legend
Soil Boring
Soil Boring (Omitted)
B-1
B-2
B-3
N
100 ft
Google Earth
© 2018 Google

MSET PROJECT NO.: 18522	LOG OF BORING NO. B-1	Page 1 of 1

PROJECT: **Electrical Substation No. 3** SITE LOCATION: **St. Charles, Illinois**

BORING LOCATION: **IL1201-989625E, 1912120N** CLIENT: **City of St. Charles**

DEPTH (feet)	SOIL TYPE	Material Description	Elevation	SAMPLE TYPE/ INTERVAL	SAMPLE NO.	SAMPLE N-VALUE Blows per ft.	TESTS Wc%	TESTS Dry Unit Weight, pcf	TESTS Unconfined Compressive Strength, tsf	REMARKS
0		FILL - Brown Crushed Stone (12")	99.5							
		FILL - Dark Brown Sandy Lean CLAY with Gravel, CL	98.5	SS	1	7	18			
2.5		FILL - Black SAND with Cinders and Slag, SP	96.5	SS	2	9	24			
5		Black Fat CLAY, CH	94.5							
		Dark Grey Sandy Lean CLAY, CL	94.0	SS	3A	8	19	105	1.82	Cave-in at 5.9' upon completion
7.5		Brown Clayey SAND with Gravel, SC, moist	92.5	SS	3B	60	18		--	
		Auger Refusal at 8.2' Dolomitic LIMESTONE	91.3							

WATER LEVEL OBSERVATIONS, ft.
DURING DRILLING: None
IMMEDIATELY AFTER DRILLING: Dry
DELAYED READING AFTER

MSET

BORING STARTED: 10/11/18
BORING COMPLETED: 10/11/18
LOGGED BY: GPF
BORING METHOD: H.S.A.

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MSET PROJECT NO.: 18522	LOG OF BORING NO. B-2	Page 1 of 1

PROJECT: **Electrical Substation No. 3** SITE LOCATION: **St. Charles, Illinois**

BORING LOCATION: **IL1201-989661E, 1912126N** CLIENT: **City of St. Charles**

DEPTH (feet)	SOIL TYPE	Material Description	Elevation	SAMPLE TYPE/ INTERVAL	SAMPLE NO.	SAMPLE N-VALUE Blows per ft.	TESTS Wc%	TESTS Dry Unit Weight, pcf	TESTS Unconfined Compressive Strength, tsf	REMARKS
0		FILL - Brown Crushed Stone with Cobbles	100.4							
				SS	1	11	9			
2.5										
				SS	2	2				No recovery, cave-in at 3.7' upon completion
5		wet at 6.0'								
				SS	3	4				No recovery
7.5										
				SS	4	3	13			
10										
		Auger Refusal at 10.8' Dolomitic LIMESTONE	89.6							

WATER LEVEL OBSERVATIONS, ft.
DURING DRILLING: 6.0'
IMMEDIATELY AFTER DRILLING: Dry
DELAYED READING AFTER

MSET

BORING STARTED: 10/11/18
BORING COMPLETED: 10/11/18
LOGGED BY: GPF
BORING METHOD: H.S.A.

GENERAL NOTES

PARTICLE SIZE DESCRIPTION & TERMINOLOGY

Coarse Grained or Granular Soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as: clays or clayey silts if they are cohesive and silts if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and the fine grained soils on the basis of their strength or consistency and their plasticity.

Major Component of Sample	Size Range
Boulders	
Cobbles	8 inches to 3 inches (200 mm to 75mm)
Gravel	3 inches to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt	Passing #200 sieve (0.075mm to 0.002mm)
Clay	Smaller than 0.002mm

Descriptive Term of Components Also Present in Sample	Approximate Quantity (Percent)
Trace	1 - 9
Little	10 - 19
Some	20 - 34
And	35 - 50

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

GRANULAR SOILS

DENSITY CLASSIFICATION	APPROXIMATE RANGE OF N *
Very Loose	0 - 3
Slightly Dense	4 - 9
Medium Dense	10 - 29
Dense	30 - 49
Very Dense	50 - 80
Extremely Dense	80 +

COHESIVE SOILS

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH, Qu - TSF	APPROXIMATE RANGE OF N *
Very Soft	0.25	0 - 2
Soft	0.25 - 0.49	3 - 4
Firm	0.50 - 0.99	5 - 8
Stiff	1.00 - 1.99	9 - 15
Very Stiff	2.00 - 3.99	16 - 30
Hard	4.00 - 8.00	31 - 50
Very Hard	8.00 +	Over 50

* STANDARD PENETRATION TEST (ASTM D1586) - A 2.0" outside-diameter, split barrel sampler is driven into undisturbed soil by means of a 140 pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven 3 successive 6 inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).